THE DISTRIBUTION OF THE ICHTHYOFAUNA IN THE SIMETO BASIN (SICILY)

by

Venera FERRITO and Concetta TIGANO (1)

ABSTRACT. - The results obtained during fifteen years (1977-1992) about the fish fauna distribution in 48 stations of the Simeto basin are reported. We have recorded 19 species of teleosts belonging to 13 families. The comparison between the present distribution of the fish fauna and that existing in past years (Tigano, 1983) indicates that the ichthyofauna met with a remarkable alteration and a general impoverishment.

RÉSUMÉ. - Les recherches effectuées pendant quinze années (1977-1992) sur la distribution des poissons de 48 stations du bassin de la rivière Simeto ont permis de répertorier 19 espèces de téléostéens appartenant à 13 familles. La comparaison entre leur distribution actuelle et passée (Tigano, 1983) montre une altération remarquable et un appauvrissement général des peuplements.

Key-words. - Teleosts, Sicily, Simeto river, Fish distribution.

The research made on the European river ecosystems, in the last decade, shows the impact of human activities on the fluvial biocoenoses. The qualitative and quantitative data available for the ichthyofauna, within the last century, allow us to follow its alteration and to individualize the reasons for its impoverishment in most of the rivers studied (Alessio and Gandolfi, 1983; Arrignon, 1988; Philippart *et al.*, 1988).

Present knowledge about the fish populations of the Sicilian rivers is poor. The more recent data concern the ichthyofauna of a few rivers of the Simeto basin (Tigano, 1983; Tigano and Ferrito, 1986, 1988, 1991; Ferrito, 1990) and of the Salso or Southern Imera basin (Tigano and Ferrito, 1985), in central and eastern Sicily. In this work we report the results of new investigations along the course of the Simeto river and of its tributaries and we review the distribution of the ichthyofauna in the Simeto basin since 1977 up to now.

MATERIAL AND METHODS

Since 1977 up to now, we have examined 48 stations (Table I) in the Simeto basin. The stations are localized both along the course of the Simeto river and along some tributaries (Figs 1, 2). We have made 109 catches of fish in all, by netting, and we have examined a total of 413 specimens. The material studied, fixed in 10% formalin and stored in 70% ethyl alcohol, is deposited at the Department of Animal Biology of the University of Catania.

---

(1) Dipartimento di Biologia Animale, Università, 95124 Catania, ITALY.

Table I. - List of the rivers and stations examined in the Simeto basin with abbreviations of the station names and their number, UTM co-ordinates and catch dates.

River and Stations		U.T.M.	Catch date
Simeto (Si)			
Si_1	Ponte Bolo	VB 8287	21 Nov. 88, 18 Apr. 91
Si_2	Ponte Passo Paglia	VB 8280	12 Oct.-21 Nov. 88, 23 Aug.-22 Sep. 89, 15 Apr. 91
Si_3	Ponte Pietrerosse	VB 8076	24 Jul. 91
Si_4	Ponte dei Saraceni	VB 8273	23 Nov. 88, 13 Mar.-24 Aug. 89
Si_5	Santa Domenica	VB 8271	24 Jul. 91
Si_6	Ponte Maccarrone	VB 8167	13 Oct.- 23 Nov. 88, 20 Mar. 89
Si_7	Barcavecchia	VB 8366	7 May 81, 23 Nov. 88, 20 Mar. 89, 24 Jul. 91
Si_8	Ponte Pietralunga	VB 8759	18 Jan.-26 Feb. 78, 24 Nov. 88, 22 Mar. 89, 24 May 91
Si_9	Castellaccio	VB 8758	26 Feb.-21 Jul.-29 Sep. 80, 29 Apr.-28 May-2 Jul. 81, 5 Jun. 87, 4 May 88, 24 May 91
Si_{10}	Ponte Barca	VB 8854	27 Sep. 80, 27 May 81, 24 May 91
Si_{11}	Ponte Giarretta	VB 9145	16 Jan.-12 Mar.-2 Jun. 81, 22 Mar. 89, 16 May 91
Si_{12}	Ponte Impero	WB 0241	30 Oct. 80, 30 Nov. 81, 3 May 91
Si_{13}	Ponte Primosole	WB 0440	3 May 91
Si_{14}	Ponte Primosole	WB 0539	18 Nov. 77, 19 Dec. 88, 30 Jun.-24 Jul.90, 3 May 91
Saracena (Sa)			
Sa_1	Chiusitta	VB 8598	25 Aug. 89
Cuto' (Cu)			
Cu_1	Vitalone	VB 7791	21 Oct. 89, 22 Apr. 91
Troina di Sotto (Str)			
Str_1	Cugno di Carcaci	VB 7669	28 Sep. 84
Troina (Tr)			
Tr_1	Ponte Borgonovo	VB 6884	28 Sep. 84
Tr_2	Serravalle	VB 8284	23 Nov. 88, 20 Mar.-24 Aug. 89
Salso (Sal)			
Sal_1	Bivio Salso	VB 4477	10 Oct. 84, 8 Oct. 91
Sal_2	Fontana di Piazza	VB 4875	10 Oct. 84
Sal_3	Contrada Comune	VB 5869	28 Sep. 84, 8 Oct. 91
Sal_4	Santa Venera	VB 7070	28 Sep. 84
Sal_5	Contrada Miraglia	VB 7469	28 Sep. 94
Sal_6	Masseria D'Aragona	VB 8066	23 Nov. 88, 20 Mar. 89
Mandre (Ma)			
Ma_1	Poggio Sperone	VB 4376	10 Oct. 84, 8 Oct. 91
Cerami (Ce)			
Ce_1	Contrada Manzuolo	VB 5185	29 Jul.-25 Sep. 84, 3 Jun. 86, 2 Jun. 88, 7 Oct. 91
Ce_2	Ponte di Cerami	VB 5581	7 Oct. 91
Ce_3	Contrada Caferferi	VB 5677	7 Oct. 91
Ce_4	Monte S. Pietro	VB 5676	2 Jun. 88
Ce_5	Campograsso	VB 5573	10 Oct. 84, 20 May-5 Dec. 86, 2 Jun. 87, 17 Jun. 91
Bozzetta (Bo)			
Bo_1	Pirato	VB 4462	7 Jul. 92
Dittaino (Di)			
Di_1	Passo di Catalano	VB 4761	7 Jul. 92
Di_2	Masseria Tuttobene	VB 5059	7 Jul. 92
Di_3	Contrada Vanadia	VB 5357	7 Jul. 92
Di_4	Cuticchi	VB 5755	7 Jul. 92
Di_5	Masseria Schembari	VB 7256	7 Jul. 92
Di_6	Contrada Muglia	VB 7254	4 Jun. 90, 11 Jun. 91, 7 Jul. 92
Di_7	Masseria Stimpato	VB 8243	11 Jun. 91
Di_8	Passo Noce	VB 9140	11 Jun. 91
Gornalunga (Go)			
Go_1	Contrada Massineo	VB 5945	8 Jul. 92
Go_2	Masseria Cugno	VB 6543	8 Jul. 92
Go_3	Casal D'Urso	VB 7045	8 Jul. 92
Go_4	Tenutella	VB 7241	8 Jul. 92
Go_5	Gabella	VB 7643	8 Jul. 92
Go_6	Masseria Palmeri	VB 8539	8 Jul. 92
Go_7	Favotto	VB 8939	31 May 91
Go_8	Passo Martino	WB 0038	28 Jun. 81, 31 May 91, 8 Jul. 92

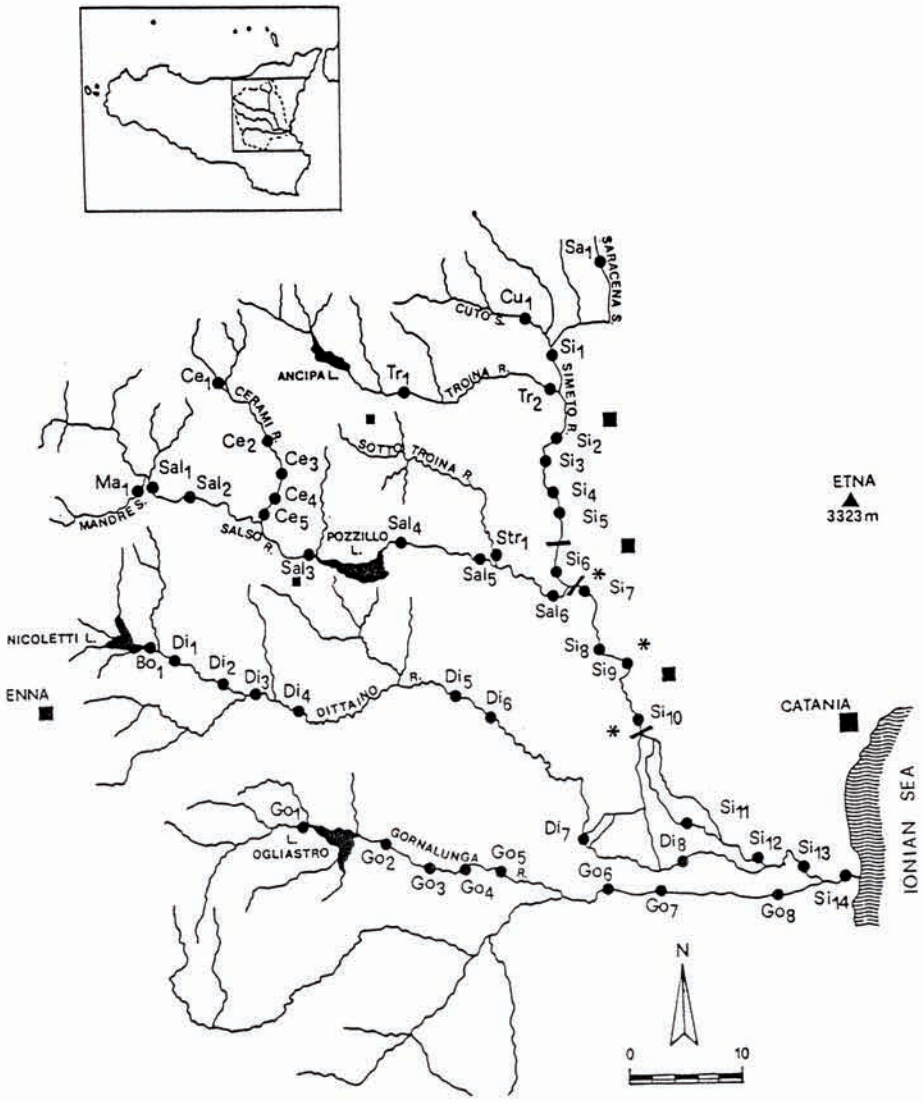

Fig. 1. - Simplified catchment area of the Simeto basin with the stations examined (black disks) since 1977 up to now. The barrages (–), the hydro-electric power plants (*) and the more important towns (■) are indicated. For abbreviations see table I. L.= Lake; R.= River; S.= Stream.

RESULTS

In the last fifteen years we have noticed the presence of 19 fish species belonging to 13 families. The fifteen years are divided into quinquennia and the presence of the species

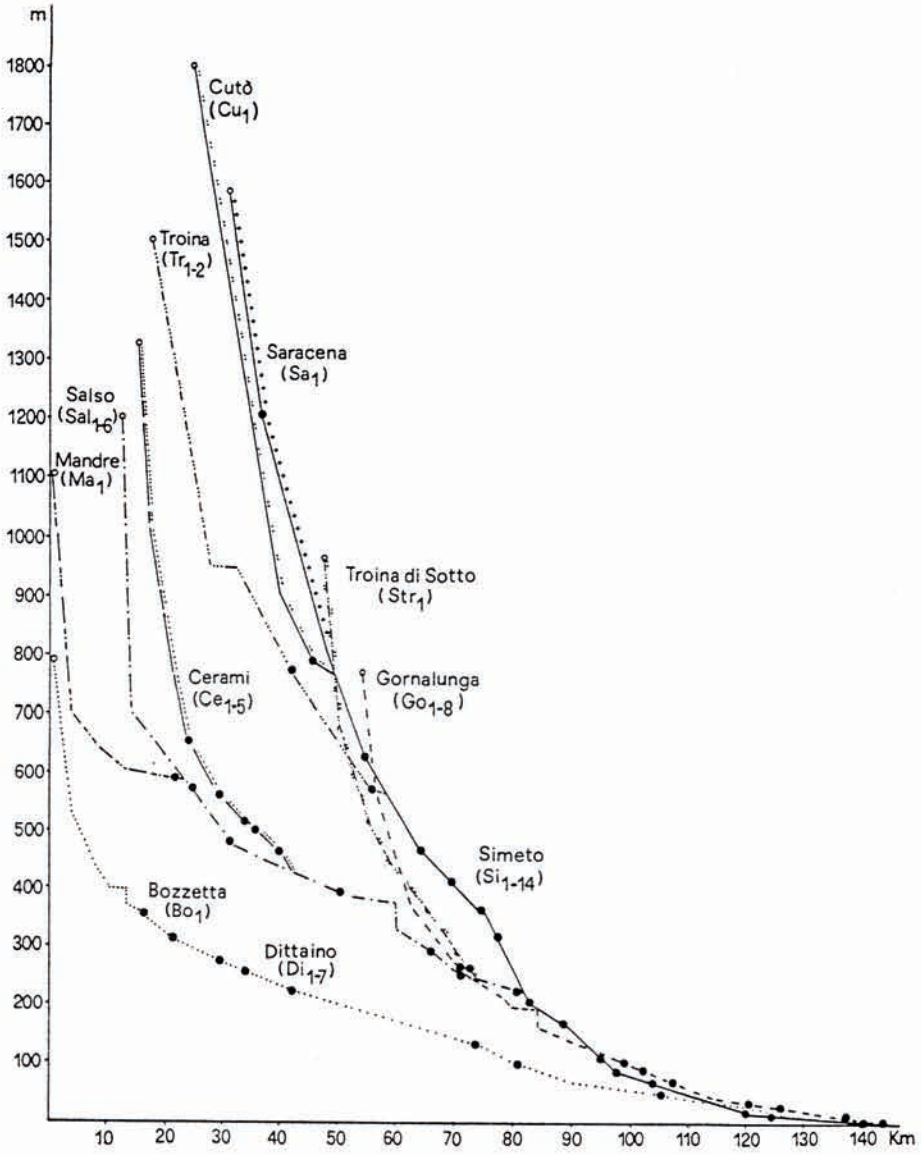

Fig. 2. - Localization of the stations examined (dark spots) along the longitudinal profiles of the Simeto river and its tributaries. Abscissa = distance from the source; ordinate = altitude. For abbreviations see table I.

during a quinquennium is indicated in brackets as follows: (1) 1977-1982, (2) 1983-1987, (3) 1988-1992 (for station name abbreviation see table I). The distribution of the 19 fish species noticed is indicated in figure 3.

Fam. Anguillidae

Anguilla anguilla (Linnaeus, 1758). - Collecting localities: (1) SI 8, SI 9, SI 10, SI 14; (3) SI 14.- Material examined: Simeto river, 17 specimens.

Fam. Engraulidae

Engraulis encrasicholus (Linnaeus, 1758). - Coll. loc.: (1), (3) SI 14. - Simeto river, 1 spm.

Tortonese (1970) states that the coastal form living in the gulf of Catania and at the mouth of the Simeto river has a smaller size than the pelagic form.

Fam. Cyprinidae

Rutilus rubilio (Bonaparte, 1837). - Coll. loc.: (2) CE 1, CE 5, SAL 3; (3) SI 6, SI 7, SI 8, SI 9, SI 11, CE 1, CE 3, CE 4, CE 5, SAL 3, SAL 6, DI 1, GO 1, GO 5, GO 8. - Simeto river, 6 spms; Salso r., 3 spms; Cerami r., 62 spms; Dittaino r., 1 spm; Gornalunga r., 3 spms.

We have recently recorded the presence of *R. rubilio* in Sicily (Tigano and Ferrito, 1986, 1988) and we have noticed that the values of some morphometric and meristic characters of the Sicilian populations are different from those of specimens of comparable size belonging to peninsular populations (Bianco and Taraborelli, 1985). *R. rubilio* spread very rapidly in the Simeto basin and now it is the only species present in some stations where, before, many other species were present (Tigano, 1983).

Tinca tinca (Linnaeus, 1758). - Coll. loc.: (1) SI 7, SI 8, SI 9, SI 10, SI 11; (3) SI 2, SI 3, SI 5. - Simeto river, 19 spms.

Sommani (1969) and Gandolfi *et al.* (1991) state that the Sicilian populations of *T. tinca* derive from specimens introduced into Sicily in the past. *T. tinca* was very abundant in the Simeto river in the past (Gemmellaro, 1864; Sicher, 1898) and Tigano (1983) recorded its presence in the middle and lower Simeto; now *T. tinca* is present only in the upper Simeto.

Cyprinus carpio Linnaeus, 1758. - Coll. loc.: (1) SI 9, SI 11; (3) SI 9, SAL 6. - Simeto river, 12 spms; Salso river, 1 spm.

All the specimens examined belong to the variety "carpa a specchi" or "di Galizia".

Sommani (1969) states that *C. carpio* was introduced into Sicily at the beginning of the 20th century, but formerly Rafinesque (1810) cited the species among the freshwater fishes of Sicily. We found *C. carpio* sporadically in the Simeto basin.

Carassius auratus (Linnaeus, 1758). - Coll. loc.: (1) SI 7, SI 9, SI 10, SI 11; (3) SI 2, SI 3, SI 4, SI 5, SI 8, SI 10, SAL 6, DI 1, GO 8. - Simeto river, 13 spms; Salso river, 1 spm; Dittaino river 1 spm; Gornalunga river, 1 spm.

The presence of *C. auratus* in Sicily was recorded from the beginning of the 19th century by Rafinesque (1810). Now the species is quite usual in the Simeto basin.

Fam. Ictaluridae

Ictalurus sp.. - Coll. loc.: (3) SI 8, SI 9.

The species was signalized only by local fishermen.

Fam. Esocidae

Esox lucius Linnaeus, 1758. - Coll. loc.: (3) SI 8, SI 9.

The species was signalized only by local fishermen.

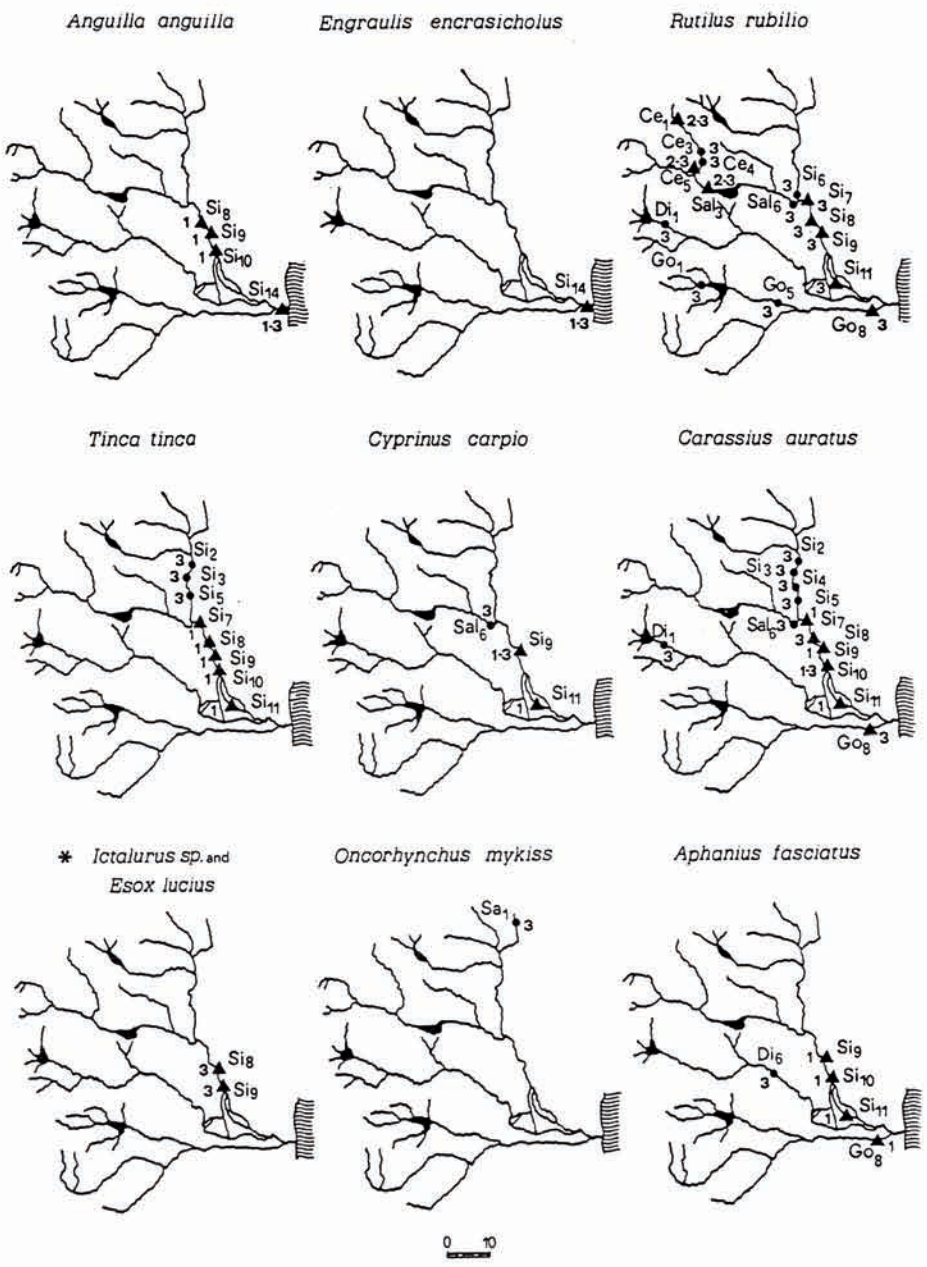

Fig. 3. - Distribution of the fish species in the Simeto basin. The stations examined since 1977 up to now are reported: the dark triangles indicate those examined in two different quinquennia; dark spots indicate the remaining stations. The numerals indicate the quinquennium in which the species was found: (1) 1977-1981; (2) 1982-1986; (3) 1983-1992. For abbreviations see table I. The artificial lakes are blackened. Asterisk = species signalized only by fishermen.

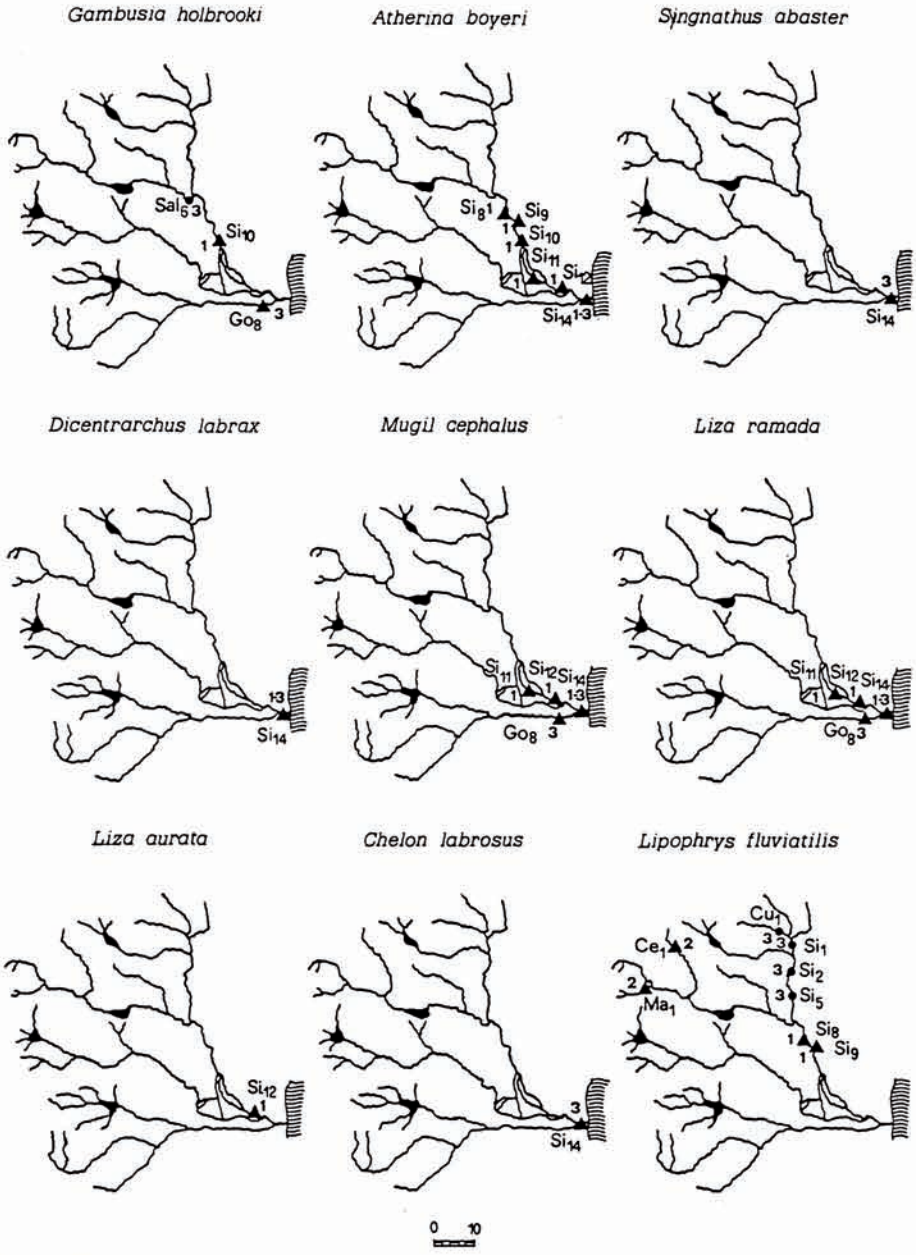

Fig. 3. - (continued).

Fam. Salmonidae

Oncorhynchus mykiss (Walbaum,1792). - Coll. loc.: (3) SA 1. - Saracena stream, 1 spm.

This species was introduced into the Simeto basin a few years ago and some local

fishermen indicated that it is present, with few specimens, in the Saracena stream. It seems that this species, introduced in Europe around 1880, cannot normally reproduce in Italy (Gandolfi *et al.*, 1991).

Fam. Cyprinodontidae

Aphanius fasciatus Nardo, 1827. - Coll. loc.: (1) SI 9, SI 10, SI 11, GO 8; (3) DI 6. - Simeto river, 137 spms; Dittaino river, 5 spms; Gornalunga river, 20 spms.

The study of some osteological characters in *A. fasciatus* populations from several Italian peninsular and insular localities, including the population of the Simeto river recorded by Tigano (1983), showed the presence of a considerable polymorphism (Tigano and Parenti, 1988; Tigano, 1991).

Fam. Poeciliidae

Gambusia holbrooki Girard, 1859. - Coll. loc.: (1) SI 10, (3) SAL 6, GO 8. Simeto river, 9 spms; Salso river, 1 spm; Gornalunga river, 5 spms.

Fam. Atherinidae

Atherina boyeri Risso, 1810. - Coll. loc.: (1) SI 8, SI 9, SI 10, SI 11, SI 12, SI 14; (3) SI 14. - Simeto river, 22 spms.

Fam. Syngnathidae

Syngnathus abaster Risso, 1810. - Coll. loc.: (3) SI 14. Simeto river, 5 spms.

Doderlein (1878-79) noticed the presence of *S. abaster* in Sicilian waters but we report, for the first time, the presence of the species at the mouth of the Simeto river.

Fam. Moronidae

Dicentrarchus labrax (Linnaeus, 1758). - Coll. loc.: (1) SI 14; (3) SI 14. - Simeto river, 4 spms.

Fam. Mugilidae

Mugil cephalus Linnaeus, 1758. - Coll. loc.: (1) SI 11, SI 12, SI 14; (3) SI 14, GO 8. - Simeto river, 8 spms; Gornalunga river, 1 spm.

Liza ramada (Risso, 1826). - Coll. loc.: (1) SI 11, SI 12, SI 14; (3) SI 14, GO 8. - Simeto river, 18 spms; Gornalunga river, 1 spm.

Liza aurata (Risso, 1810). - Coll. loc.: (1) SI 12. - Simeto river, 1 spm.

Chelon labrosus (Risso, 1826). - Coll. loc.: (3) SI 14. Simeto river, 7 spms.

We notice, for the first time, the presence of *C. labrosus* at the mouth of the Simeto river.

Fam. Blenniidae

Lipophrys fluviatilis (Asso, 1801). - Coll. loc.: (1) SI 8, SI 9; (2) CE 1, MA 1; (3) CU 1, SI 1, SI 2, SI 5. - Cutò stream, 2 spms; Simeto river, 21 spms; Cerami river, 2 spms; Mandre stream, 2 spms.

Comparison between the distribution of the fish fauna in the last quinquennium and that existing in past years (Tigano, 1983) shows that:

Three species have been introduced to the basin: *Rutilus rubilio*, *Esox lucius* and *Ictalurus sp.*

One species has disappeared: *Aphanius fasciatus*; and others have sensibly reduced their distribution in the basin: *Lipophrys fluviatilis*, *Tinca tinca* and *Cyprinus carpio*.

The euryaline species, diadromous or not, are present only at the mouth of the Simeto river: *Anguilla anguilla*, *Atherina boyeri*, *Mugil cephalus* and *Liza ramada*. In the past these species were found far from the mouth (Table II).

DISCUSSION

The Italian southern peninsula together with Sicily and Sardinia do not correspond to a particular ichthyogeographic district because they have a very poor fish fauna. Sicily particularly is lacking in endemic species and in autochthonous primary freshwater fishes (Bianco, 1982; Gandolfi *et al.*, 1991). The paleogeographic and paleoclimatic events which occurred in southern Europe, as from the Tertiary, could certainly explain this lack of species (Banarescu, 1975). Therefore the existing primary freshwater fish populations have been introduced to Sicily in more or less recent times.

As regards the fish fauna of the Simeto basin, we can put the species present in the following categories of freshwater fishes: 1) Primary freshwater fishes: *Rutilus rubilio, Tinca tinca, Cyprinus carpio, Carassius auratus*; 2) Secondary division freshwater fishes: *Aphanius fasciatus, Gambusia affinis*; 3) Diadromous freshwater fishes: *Anguilla anguilla*; 4) Complementary freshwater: *Lipophrys fluviatilis*; 5) Sporadic freshwater fishes: *Engraulis encrasicholus, Atherina boyeri, Syngnathus abaster, Dicentrarchus labrax, Mugil cephalus, Liza aurata, L. ramada, Chelon labrosus.*

It seems to be rather doubtful to differentiate a zonation, based on the longitudinal succession of fish communities, in the rivers of the Simeto basin. Any such attempt must be done with prudence. Sommani (1952) and Zerunian (1982) state that it is difficult to fit the longitudinal zonation, developed by Huet (1949) for the rivers of central and western Europe, respectively to Sicilian rivers and to central and southern rivers of the Italian peninsula. Our results and those in the literature (Tigano, 1983), in accordance with the zonation of Zerunian (1982), allow us to define along the Simeto river only two zones: the limnophilic Cyprinids zone and the brackish water zone. The presence of *Oncorhynchus mikyss* in the Saracena stream could lead us to consider also a third zone, that of the trout; but this is impossible because this species, introduced in the Saracena stream for the last few years, cannot normally reproduce (Gandolfi *et al.*, 1991).

From these considerations about the present distribution of the fish populations in the Simeto basin, we can conclude that the fish fauna, in the last fifteen years, met with great alterations and a great impoverishment; this is particularly evident in the tract of the Simeto river between the confluence with the Salso river and the mouth (Si 7-14) (Table II). In this tract, where the stations were examined in two different quinquennia, if we exclude the station near the mouth, where many euryaline species are present, we found now only three species: *R. rubilio, Cyprinus carpio* and *Carassius auratus*; in the same tract Tigano (1983) noticed the presence of eleven species (Table II).

The rarefaction seems very alarming especially of the indigenous species of the Mediterranean area such as *Aphanius fasciatus* and *Lipophrys fluviatilis*, the great scientific interest of which has been recently noticed (Almaça, 1988). The disappearance of the population of *A. fasciatus* from the Simeto river is particularly regrettable because the

Table II. - Fish species noticed during the last fifteen years along the lower Simeto and some tributaries. Only the 13 stations examined in two different quinquennia are reported. a: absent, p: present; a dash indicates that the species has not been found. The numerals indicate the quinquennium in which the species was found: (1) 1977-1981; (2) 1982-1986; (3) 1983-1992. For abbreviations see table I.

Species	Si7		Si8		Si9		Si10		Si11		Si12		Si14		Ma1		Sal3	
Anguilla anguilla	-	-	p (1).	a (3)	p (1).	a (3)	p (1).	a (3)	-	-	-	-	p (1).	p (3)	-	-	-	-
Engraulis encrasicholus	-	-	-	-	-	-	-	-	-	-	-	-	p (1).	p (3)	-	-	-	-
Rutilus rubilio	a (1).	p (3)	a (1).	p (3)	a (1).	p (3)	-	-	a (1).	p (3)	-	-	-	-	-	-	p (2).	p (3)
Tinca tinca	p (1).	a (3)	p (1).	a (3)	p (1).	a (3)	p (1).	a (3)	p (1).	a (3)	-	-	-	-	-	-	-	-
Cyprinus carpio	-	-	-	-	p (1).	p (3)	-	-	p (1).	a (3)	-	-	-	-	-	-	-	-
Carassius auratus	p (1).	a (3)	a (1).	p (3)	p (1).	a (3)	p (1).	p (3)	p (1).	a (3)	-	-	-	-	-	-	-	-
Ictalurus sp.	-	-	a (1).	p (3)	a (1).	p (3)	-	-	-	-	-	-	-	-	-	-	-	-
Esox lucius	-	-	a (1).	p (3)	a (1).	p (3)	-	-	-	-	-	-	-	-	-	-	-	-
Aphanius fasciatus	-	-	-	-	p (1).	a (3)	p (1).	a (3)	p (1).	a (3)	-	-	-	-	-	-	-	-
Gambusia holbrooki	-	-	-	-	-	-	p (1).	a (3)	-	-	-	-	-	-	-	-	-	-
Atherina boyeri	-	-	p (1).	a (3)	p (1).	a (3)	p (1).	a (3)	p (1).	a (3)	p (1).	a (3)	p (1).	a (3)	-	-	-	-
Syngnathus abaster	-	-	-	-	-	-	-	-	-	-	-	-	-	p (3)	-	-	-	-
Dicentrarchus labrax	-	-	-	-	-	-	-	-	-	-	-	-	p (1).	p (3)	-	-	-	-
Mugil cephalus	-	-	-	-	-	-	-	-	p (1).	a (3)	p (1).	a (3)	p (1).	p (3)	-	-	-	-
Liza ramada	-	-	-	-	-	-	-	-	p (1).	a (3)	p (1).	a (3)	p (1).	p (3)	-	-	-	-
Liza aurata	-	-	-	-	-	-	-	-	-	-	p (1).	a (3)	-	-	-	-	-	-
Chelon labrosus	-	-	-	-	-	-	-	-	-	-	-	-	-	p (3)	-	-	-	-
Lipophrys fluviatilis	-	-	p (1).	a (3)	p (1).	a (3)	-	-	-	-	-	-	-	-	p (2).	a (3)	-	-

Italian populations of this species present a sensible polymorphism, especially for several characters of the skull (Tigano and Parenti, 1988; Tigano, 1989; Tigano, 1991; Parenti and Tigano, 1993), and also for morphological, morphometric and meristic characters (Tigano, 1982; Tigano and Ferrito, 1983-84). They are very interesting for research into microevolutionary processes, as already noticed by Villwock (1982) and Comparini *et al.* (1983-1984), which indicate the presence of different stages of "species in statu nascendi" within populations of *Aphanius* species.

The reasons of this impoverishment are certainly derived from the effects of the human impact. Along the Simeto river several dams are present (the latest was built, in the lower course, in 1985) that need fish pass. *Anguilla anguilla* and the euryaline Mugilidae and Atherinidae species cannot now reach the upstream stations as formerly noticed by Tigano (1983). Many hydraulic engineering works are present in the Simeto basin. The increased flow-variability is a consequence of the hydroelectric, industrial and irrigation exploitation of the Simeto basin rivers. The excessive water abstraction now causes the decrease of the discharge or even the drying up of long tracts of the river, especially in the dry season. In these tracts the structure of the fluvial biocoenoses is much modified and very poor (Ferrito, 1990; 1994). Water pollution is also a cause of habitat deterioration, and that of the Simeto river has been already noticed by previous workers (Maggiore *et al.*, 1983).

Acknowledgements. - This research was supported by MURST 40% programme "Fauna of the western Mediterranean area".

REFERENCES

ALESSIO G. & G. GANDOLFI, 1983. - Censimento e distribuzione attuale delle specie ittiche nel bacino del fiume Po. CNR - Istituto di ricerca sulle acque. *Quaderni*, 67: 1-92.

ALMACA C., 1988. - Compte rendu de la table ronde: Les poissons des iles de la Méditerranée occidentale (Baléares, Corse, Sardaigne, Sicile). *Bull. Ecol.*, 19(2-3): 471-472.

ARRIGNON J., 1988. - Fish and their environment in large european river ecosystems. The Loire. *Science Eau*, 7(1): 21-34.

BANARESCU P., 1975. - Principles and problems of Zoogeography. 225 p. U.S. Dept. Commerce Natl Sc. Found., Washington D.C. Publ.

BIANCO P.G., 1982. - La distribuzione dei pesci d'acqua dolce d'Italia: individuazione di 6 sotto-province ittiogeografiche. *Boll. Zool.*, 49(suppl.): 22.

BIANCO P.G. & T. TARABORELLI, 1985. - Contributo alla conoscenza del genere *Rutilus* Rafinesque in Italia e nei Balcani occidentali (Pisces, Cyprinidae). *Boll. Mus. Reg. Sc. Nat. Torino*, 3(1): 131-172.

COMPARINI A., SCATTOLIN N. & E. RODINO', 1983-84. - Genetic differentiation among some populations of the Cyprinodont *Aphanius fasciatus* Nardo. *Nova Thalassia*, 6(suppl.): 261-268.

DODERLEIN P., 1878-79. - Prospetto metodico delle varie specie di pesci riscontrate sin'ora nelle acque marine e fluviali della Sicilia annesso al prodromo della fauna ittiologica sicula ecc. *Atti Sci. Lett. Art.* Palermo, nuova serie, 6: 26-64.

FERRITO V., 1990. - Le zoocenosi del fiume Simeto. Tesi di dottorato. 319 pp. Univ. Catania.

FERRITO V., 1994. - Les macroinvertébrés benthiques de la rivière Simeto et de quelques-uns de ses affluents. *Annls. Limnol.*, 30(1): 33-56.

GANDOLFI G., ZERUNIAN S., TORRICELLI P. & A. MARCONATO, 1991. - I Pesci delle acque interne italiane. 617 p. Ministero dell'Ambiente, U.Z.I. Ist. Poligrafico e Zecca dello Stato, Roma.

GEMMELLARO C., 1864. - Saggio d'Ittiologia del Golfo di Catania. *Atti Acc. Gioenia*, 2(19): 111-158 .

HUET M., 1949. - Aperçu des relations entre la pente et les populations piscicoles dans les eaux courantes. *Schweiz. Z. Hydrol*, 11: 333-351.

MAGGIORE R., ABBATE L., SCIOTTO D. & G. SIRACUSA, 1983. - Indagine sullo stato di inquinamento sul fiume Simeto. *Inquinamento*, 3: 51-55.

PARENTI L.R. & C. TIGANO., 1993. - Polymorphic skeletal characters in *Aphanius fasciatus* Nardo and other Cyprinodontiform Fishes. *Copeia*, 1993(4): 1132-1137.

PHILIPPART J.-C., GILLET A. & J.-C. MICHA, 1988. - Fish and their environment in large european river ecosystems. The river Meuse. *Sciences Eau*, 7(1): 115-154.

RAFINESQUE S., 1810. - Indice di Ittiologia siciliana. 70 p. Messina.

SICHER E., 1898. - I pesci e la pesca nel compartimento di Catania con due note sui generi *Laemargus* e *Maena*. *Atti Acc.* XI, 4, mem. 5: 1-69.

SOMMANI E., 1952. - Il concetto di "zona ittica" e il suo reale significato ecologico. *Boll. Pesca, Pisc., Idrobiol.*, VII(1): 61-71.

SOMMANI E., 1969. - Variazioni apportate all'ittiofauna italiana dall'attività dell'uomo. *Boll. Pesca, Pisc., Idrobiol.*, 22(2): 149-166.

TIGANO C., 1982. - Le popolazioni di *Aphanius fasciatus* (Nardo 1827) della Sicilia orientale (Pisces, Cyprinodontidae). *Animalia*, 9(1/3): 153-183.

TIGANO C., 1983. - Dati preliminari sul popolamento ittico del fiume Simeto (Sicilia). *Boll. Acc. Gioenia Sci. Nat.*, 16(321): 81-98.

TIGANO C. & V. FERRITO, 1983-84. - Studio biometrico e morfologico di *Aphanius fasciatus* (Nardo) dell'Adriatico e di Sicilia (Pisces, Cyprinodontidae). *Nova Thalassia* 6 (suppl.): 679-680.

TIGANO C. & V. FERRITO, 1985. - Studio osteologico comparato del cranio di popolazioni di *Aphanius fasciatus* (Nardo) (Pisces, Cyprinodontidae) dell'Adriatico e di fiumi di Sicilia. *Animalia*, 12(1/3): 13-57.

TIGANO C. & V. FERRITO, 1986. - Sulla presenza di *Rutilus rubilio* (Bp. 1837) in Sicilia (Pisces, Cyprinidae). *Animalia*, 13(1/3): 109-124.

TIGANO C. & V. FERRITO, 1988. - Ulteriori contributi sul *Rutilus rubilio* (Bp.) con qualche particolarità osteologica (Pisces, Cyprinidae). *Boll. Mus. St. Nat. Lunigiana*, 6-7: 175-180.

TIGANO C. & L.R. PARENTI, 1988. - Homology of the median ethmoid ossification of *Aphanius fasciatus* and other Atherinomorph fishes. *Copeia*, 1988(4): 866-870.

TIGANO C., 1989. - The maxillary and premaxillary bones in *Aphanius fasciatus* Nardo (Teleostei: Cyprinodontidae). *Ann. Soc. r. zool. belg.*, 119 (suppl. 1): 29-30.

TIGANO C. & V. FERRITO, 1991. - Impoverishment of the Ichthyofauna in the Simeto River. *In*: 7th International Cong. Europ. Ichtyol. Den Haag. *Bull. Zool. Mus. Univ. Amsterdam*, spec. issue, 84.

TIGANO C., 1991. - Il polimorfismo della mascella superiore in *Aphanius fasciatus* Nardo (Pisces, Cyprinodontidae). *Animalia*, 18: 61-70.

TORTONESE E., 1970. - Osteichthyes. Pesci Ossei. Fauna d'Italia, X: 1-565. Calderini Edit. Bologna.

VILLWOCK W., 1982. - *Aphanius* (Nardo, 1827) and *Cyprinodon* (Lac. 1803) (Pisces: Cyprinodontidae), an attempt for a genetic interpretation of speciation. *Z. zool. Syst. Evol.-forsch.*, 20: 187-197.

ZERUNIAN S., 1982. - Una proposta di classificazione della zonazione longitudinale dei corsi d'acqua dell'Italia centro-meridionale. *Boll. Zool.*, 49(suppl.): 200.

Reçu le 19.03.1993.
Accepté pour publication le 15.04.1994.